Synopsis of experiences in the German Biogas - sector

History and Perspectives regarding aspects from Bio-waste to Biogas & from Biogas to Bio-methane

Within the frame of Green Energy Cooperation with Iran and Mashhad Urban Environment Municipality

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Matter of course

It`s known that Nature provides two mayor processes for the decomposition of organic material, e.g. the aerobic and the anaerobic degradation. Both produce stable chemical compounds which are the basis for new products and chains by using solar energy.

Effects of CO2 and CH4 in Climate Change: It can be assumed that the CO2 from the biogas plant will somehow and eventually be re-integrated into the natural cycle and therefore will not have any lasting climate-damaging effects. Therefore, the CO2 from the biogas plant is classified as climate-neutral. When biogas burns in an open flame, only the CH4 burns and forms CO2 again. Even if biogas is used for other chemical processes in the biofuel concept as a basis for further chemical processes, the final product is again CO2. To moderate the consequences of a climate change only will help moderate lifestyles and firm belief.

What is needed are new ways of production and working processes of any kind, reducing waste, recycling materials, recycling processes, electromobility in the transport sector. Ultimately helping the climate and all of us is finally just planting trees and stopping the destruction of the environment.

1 The biological cycle in History

The beginning of the cultivation of plants and thus supplements breeding of plant cultivation began with different sorts of grass (Barley, Emmer and EinhornTriticum monococcum) and later also with rye (Secale cereale). That was some 12.000 years ago. For the first time, plants of these species were selected and cultivated under controlled conditions. The natural degradation processes and their consequences have been recognized and used by humans since then. In various parts of the world so-called “High cultures” developed in the course of time, which the natural processes were in a certain manner recognized and utilized. The specific processes were not yet completely known, but the sequences and consequences were mastered and applied. The first garden -like places were more of a kind in which the animals were housed only during the night. They were thus protected from wild predators and members other human tribes. During the day they were pasturing the surrounding area, bringing with their dung precious minerals into the fence and finally into the gardens. Cattle breeding, agriculture and gardening and optimization processes have a long and traditional culture.

Environmental research, the exploration of the direct and immediate environment, is part of human nature. Therefore, the optimization of the environment is, so to speak, in our genes. The first real gardens of the world existed likely in Persia. They served as shelter from heat and drought, and were the halls of water. Their basic form can be traced back to the 6th century BC and had a great influence on the development of all the garden styles of the world. The oldest known garden could be the Pasargadae that Cyrus the Great had created more than 2,500 years ago. These are recorded in floor plans and later in ancient Persian book miniatures and splendid carpet. Information about a sort on garden culture is reported from Egypt, China und Mexico and other places. Later in history Garden culture is reported in turkey und Europe, mainly in Italy and later in France followed by other countries like Japan and Korea and later the US.

History and the **Gilgamesh epic** is known s first testimony for city-like dwelling. Real horticulture is reported about 3000 years ago by Babylon and the Sumerian city-state Uruk. Also over the city possibly oldest city in the world called Ur and the gardens of Shammuramath (Semiramis) in today's Iraq, exists many references.

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1.1 End of Middle Age and beginning of the modern times in Europe

With the "Reformation" (Latin: renewal, restoration) started a renewal movement in the early 16th century, which was initiated in Germany mainly by Martin Luther, in Switzerland by John Calvin and Huldrych Zwingli. The beginning of the Reformation is generally dated to October 31, 1517, the day on which the monk Martin Luther should have struck his 95 theses against the abuse of indulgences to the church door of the central church in Wittenberg, Germany. The increasing secularization and the way of life of high and low clergy as well as the salability of ecclesiastical offices exacerbated the displeasure in the population.
The new Protestant church has significantly influenced Western philosophy and way of life, as well as the economy manner of capitalism.

1.2 Renaissance and modern science

According to European time-frame the medieval age ended in the 14th century. After that, the modern era began with the Renaissance, in that the sense that science in the meaning of classical Greece and Rome came back to Europe. During the Renaissance, there have been two major setbacks, which have hindered the progress, due to the climate change from 1570-1630 and 1675-1715 which stopped progress of any kind.

1.3 Selection of some representative European scientists

The choice of European representatives is certainly subjective. Other countries would probably have named other scientists and Persia certainly reasonably others again.

1. Isaac Newton is one of the greatest scientists of all time. He wrote, inter alia, the doctrine of gravity (gravity theory) and showed the composition of light.
2. Immanuel Kant was a German philosopher of the Enlightenment. Kant is one of the most important representatives of Western philosophy and moral thinking.
3. Charles Robert Darwin was a British naturalist. He is considered one of the most important natural scientists because of his essential contributions to the theory of evolution.

4. Friedrich Wilhelm Heinrich Alexander von Humboldt was a German natural scientist with a field of influence reaching far beyond Europe

1.4 Plant Research

The ideas, more so science and new thinking of the Renaissance, captured all spheres of life from painting and architecture to philosophy and music to all areas of all sciences and medicine. Around 1750, many elements were discovered, including oxygen, nitrogen, potassium, and other elements. Ammonia is also discovered. A larger number of laws were formulated for forestry, agriculture and animal breeding.

A special researcher was the German chemist and agricultural engineer Justus von Liebig (1803-1873). He realized that the element which is present in the lowest concentration in the soil directs the growth of a plant. On the basis of its research, agricultural production in Germany could be doubled between 1800 and 1900, including sugar beet cultivation. To cover the fertilizer needs Nitrogen-containing products were imported, such as Guano from Chile and other places. To this end, feces of birds and nitre were collected from islands and transported by ship to Europe.

2 Important events in recent German history

For a better understanding some information about recent German history

The French Revolution from 1789 to 1799 with the motto “Liberté, Egalité, Fraternité” is one of the most important events of modern European history. The implementation of fundamental values and ideas of the Enlightenment as objectives of the French Revolution - in particular human rights - have contributed to deep-rooted changes in power and society across Europe and have decisively influenced modern democracy.

From this time onwards began the so called **“Imperialism”** where the whole world, which has been suppressed the so-called colonialization of whole countries and regions in Asia, Africa and Latin America.

From 1870-71 a Franco-German war ultimately led to the first world war of 1914-18, which Germany and its allies lost. This led to the Second World War of 1939-45, which Germany and its allies also lost again. Around 70 million people died, about 6 million of them were Jews. Germany lost 1/3 of its territory, took up about 20 million German refugees from its lost territory’s and was bipartite. 1900 Germany was unified.

2.1 Steps to unify Europe and ending of state nationalism

After the end of World War II, reconstruction began in Western Europe. In 1950, the Coal and Steel Community was founded in 1957 the European Economic Community (EEC) with a single market and in 2009 the European Union (EU). These events are also important in overriding the idea of nation states. In fact, the EU is still a long way from a unified single state.

2.2 Migration to Germany

After the end of the Second World War Germany was isolated politically and concentrated on the reconstruction of the completely destroyed and occupied by the victorious powers. Starting from 1950 began an economic recovery and an upturn which continues to this day. Deutschland began to add guest workers from the neighboring countries of Spain Portugal, Greece and later Morocco.

Today's citizens are fully integrated and can no longer be recognized as such. The situation is different with people from Turkey. In Deutschland there are about 4.5 million citizens of Turkish origin, about 2 million of whom are still of Turkish nationality.

Altogether, approximately 17 million foreign people have immigrated to Germany since 1950 to date.

Influence of foreign migrants on German lifestyle and sanitary conditions.

Foreign migrants have distinctly different sanitary behaviors than natives, but it has not been reported that this behavior could have had any specific impact sanitary conditions.

2.3 The Shah Visit to Germany in 1967

In the course of this unrest, there were also demonstrations against the visit of the Iranian Shah. In May to 1967, Shah Mohammad Reza Pahlavi and his wife, Shahbanu Farah Pahlavi, visited the Federal Republic of Germany and West Berlin at the invitation of Federal President Heinrich Lübke.

The invitation to the Shah took place after the state visit of President Luebke to Iran in October 1963. After the visit to Germany, the Shah and his wife traveled to France. The student protests, however, were rather an occasion and directed less against Iran itself.

2.4 The West German Student Movement

The West German student movement of the 1960s was a caesura. The students had understood rather than the politicians that the post-war era came to an end and a new movement began.

The student movement was tolerated by the population and later supported.

The whole event ultimately led to the formation of Bündnis 90 / Die Grünen in 1980. In Germany there is a 5% hurdle. Only those who receive 5% of the votes can move into the National Parliament (Bundestag). The Greens are also represented in the European Parliament and Heinrich Böll Foundation. The “Alliance 90 / The Greens” represents ecological content. Such contents are also shared by the general German population and the other parishes in this idea. This explains the general success of the ecological idea and the success of renewable energy, which ultimately led to renewable energy.

3 Political steps in the Renewable Energy sector and Climate Change

The issues of environmental protection and climate change always played an important role in German politics and society. This also explains why Germany has been a pioneer in environmental protection in Europe and around the world for many years.

Ever since the political beginning of the Federal Republic of Germany, the government and the population have been concerned about environmental protection. Germany can justifiably be considered a pioneer in environmental climate issues Pioneer in environmental protection in Europe and around the world.

The Federal Ministry for Economic Cooperation and Development (BMZ) is making a decisive contribution to this, as climate change and development are inextricably linked.

See annex 1: COP23 in Bonn Germany

3.1 German sensitivities to environmental protection and climate change

The relationship with nature, forests and rivers, weather and storms and the animals and plants that live in them have always played a nearly romantic, but decisive, role in German history.

Therefore, issues of environmental protection and climate change always played an important role in politics. This also explains why Germany has been a pioneer in environmental protection in Europe and throughout the world for many years, however has Germany and the EU has fallen behind for some time behind its self-imposed goals. The EU says that greenhouse gas emissions will have to be reduced by at least 40% by 2030 relative to 1990, and by 2050 it will even reach 80-95%. But it could be that Germany does not succeed in reducing its own target by 40% by 2020 on the basis of allowances. The certificate will range from 5 to 7€. That is far too little and would have to be five times more expensive. Major German electricity suppliers propose a minimum price of 30 €.

3.2 Discovery of human influence on the climate

Since about 19 years it has been assumed that human activities influence the weather, from 1950 it was assumed that the increasing share of CO2 could have something to do with the warming, from 2000 onwards there was no doubt about anthropogenic influences among scientists.

There were hundreds of indicators from scientific weather reports and reports of changes in the plant and animal spheres. In these reports, positive consequences are also reported, but in general negative consequences prevail because changes in only 100 years cannot be compensated by nature.

It is a matter of time that shifts climate zones. Scientists assume that climate conditions will be in Germany in about 100 years from now on like todays region south of the Alp Mountains and todays Mediterranean regions will be like North Africa’s semi desert climate.

3.3 Geographical changes and rising sea level

Anticipated geographical changes and rising sea levels will lead to mayor regional changes. If there are semiarid conditions in today's Mediterranean region, the changes will be huge. That applies to Europe and equally to Iran. The sea level could be about 50 meters higher in 100 years than today, which would have the result that many islands are flooded and coastlines will look very different. The same forces acting on Germany will also change Iran and its shorelines.

3.4 The Paris Climate Conference

After about 20 years of continual clashes between developed and developing countries, finale the Paris Climate Conference was held. It was called:

The United Nations Climate Change Conference in Paris 2015

The United Nations Climate Change Conference in Paris 2015 (21st Conference of the Parties, COP 21) took place as the 21st UN Climate Change Conference and 11th Meeting of the Kyoto Protocol (English 11th Meeting of the Parties to the 1997 Kyoto Protocol, CMP 11 for short) from November 30 to December 12, 2015 in Paris This conference was considered of central importance, as a new international climate protection agreement should be adopted here as a follow-up to the Kyoto Protocol. The target was to maintain 2°C or even better to lower it to 1.5°C.

At the conference, it was decided that each country would draw up a road map that could be made to limit a climate change. But it has to be remembered that there are nearly 200 countries in the world and that the US could get out of Paris climate commitments. Now Germany and Iran are important countries, but each contributes only slightly to climate change. Germany is responsible for 0.03 ° C. Iran's value is much lower, but it cannot be ignored, because of its oil and gas share and associated emissions of methane (At the conference, it was decided that each country would draw up a road map that could be made to limit a climate change. But it has to be remembered that there are nearly 200 countries in the world and that the US could get out of Paris climate commitments. Now Germany and Iran are important countries, but each contributes only slightly to climate change. Germany is responsible for 0.03 °C. Iran's value is much lower, but it cannot be ignored because of its oil and gas share and associated emissions of methane (Gas linkages).

3.5 The „Renewable Energy law“

In 1981 the law „Supply of electricity from renewable energies in the grid“ was passed in German Federal Parliament followed by the „Renewable law“ in 1991. That law was worldwide the first law to regulate feed-in conditions in the national grid. It is understood as a masterpiece of German Technology, that permanently changing Renewable electricity production due to natural phenomes, now days up to 35% can be absorbed by the

grid without mayor problems. Electricity from Biogas is welcome in that context because it can be regulated and thus stabilizing the grid because it can feed in when needed. It can be stored and feed in when required what is not possible with fluctuating wind and solar energy.

3.6 Course title Renewable Energy Law, EEG 2017

This law regulates the penetration of RE-Electricity into the grid and guaranties subsidies under various conditions, what means that the subsidized conditions can and will be changed accordingly market conditions. The law regulates the preferential supply of electricity from renewable sources to the electricity grid and guarantees their producers fixed feed-in tariffs. While the EEG proved to be "very successful" with regard to the expansion of Renewable Energies, its economic and ecological efficiency as well as partial aspects, such as exemptions for the industry are controversially discussed. Each consumed KWh is charged with the so called "Green electricity supply". It is slightly less than 10 Euro-cents in 2017. Large electricity consumers can be exempted from the "Green electricity requirements" for economic policy reasons. The payment for the consumers to the energy producers is not regarded as a subsidy but as an agreement. The EEG 2017 is not understood as very balanced, however.

3.7 Adoption of the European Economic Community and the European Atomic Energy Community (Euratom) in 1957

The EEC laid the foundations for the present EU and created it.

Even at the time of the signing, a possible enlargement of the contract to all European states was considered.

The European Union (EU) of today is a network of currently 28 member states. Outside of Europe, the EU also covers some overseas territories. It has more than half a billion inhabitants. In terms of gross domestic product, the EU's internal market is the second largest common economic area in the world. The EU is an independent legal personality and has, therefore, a sense of authority and right of rejection at the United Nations.

3.8 Energy transition in Germany and Europe

The Energy transition in Germany and Europe can be seen under the aspects of harmonization of the European grid, energy saving and climate change. In general is it considered as relatively successful but it hampers on different corners, most of them are national-made with specific often selfish peculiarities. The total goal to lower the emissions from 1990 to 2020 by 20% will be reached, however. Germany will not reach its own targets due to the strong position of the automobile sector and Lignite production for electricity production. In the long run Germany will shut down however Power generation from brown coal.

3.9 The ring of fire: Nuclear power plants surrounding Germany

Atomic energy was introduced very hesitantly in Germany, but then further expelled as research and energy supply companies dominated the technology.

The relationship with nature, forests and rivers, weather and storms, and the animals and plants that live in them have always played partially a romantic, but decisive, role in German history.

In Europe, 74 nuclear power plants are shut down in 17 countries with 184 reactor blocks on the grid. In France, 19 nuclear power plants with 58 reactor units and a total installed gross capacity of 66,130 MW are connected to the grid. Four nuclear power plants and twelve reactor units with a total output of 4,098 MW have already been shut down.

In Belgium, there are four nuclear power plants in operation and two in the Netherlands, four in Switzerland and eight in England. There are hundreds in Russia and the Ukraine. In Germany, there are currently 12 nuclear power plants on the grid. In former times they were about including research reactors more than 100. After a long and controversial discussion all reactors should be closed in 2022, all activities should be completed by 2014.

Germany and the Germans are particularly afraid of the nuclear power plants in England, the Netherlands, Belgium and Switzerland. All plants were built on their eastern borders, so that in the case of a nuclear catastrophe, the radioactive Fall-out with the prevailing westerly wind is carried to the respective eastern countries.

3.10 The reactor catastrophe in Fukushima in Japan

The reactor catastrophe in Fukushima changed the roles of the game. It was a turning point for Germany's energy companies. In 2011, the Federal Government imposed a moratorium on several nuclear power plants. Eight reactors were permanently withdrawn from the grid and the Bundestag (National Parliament) decided Germany's final exit from nuclear power generation by the end of 2022.

3.11 Changing of the rules in the Energy sector

For a long time, few major conglomerates dominated the energy industry in Germany since the Industrial Revolution in the 19th century. However, government-sponsored competition and the phasing-out of nuclear power now cut off the four main power producers in Germany which are E.ON, RWE, Vattenfall and EnBW, they all were close to bankrupt and had to change its business-model drastically. At the same time, citizens with solar systems and medium-sized companies with wind parks themselves become electricity producers.

In parallel the production costs of Solar and wind energy dropped dramatically, that’s why more and more private entrepreneurs got themselves power-producer and fed the surplice of energy which they could not consume by themselves, into the grid.

It is predictable that all major power producers worldwide will have to change their business model because it is simply no longer economical. Cheap solar and wind power will make it possible to undertake ventures which have so far failed due to excessive electricity prices. There will consequently be a variety of small to very small companies nationwide.

4 The liquid phase of the wastewater from the biogas plant as a water-source for gardening, planting vegetables and herbs and medicine plants

The question for the origin of the material what is being filled into the biogas plant has to be clarified, e.g. where does it originally come from? From a listing to be created, follows which substrate was filled in a biogas plant and where the material came from.
If it is for example imported concentrated fodder, this complex is outsourced and defined as a problem of the supplier country, which was regulated the bought to be fed. In the case of food leftovers that ultimately end up in a biogas plant, can also be so preceded and theoretically subsumed under minor water import.
After the substrate has been filled with water and the fermentation process has been completed, the sludge is removed including any contained solids. Then the question of how this aqueous substrate should be treated has to be clarified.
It is advisable to dewatering and possibly drying the substrate for further uses.
The water obtained by the dehydration can preferably be used in gardens planting vegetables and herbs or even medicine plants.

Option 1: The liquid and muddy vinasse from the biogas plant flows into a settling tank and from there into prepared channels in a garden field whose size is adapted to the water supply from the respective biogas plant. Subsequently, classical irrigation can be cultivated with all imaginable sub-levels such as submerged irrigation, addition of other herbicides or pesticides etc. The addition of water depends on the needs of the respective plants and growing season and market situation. Through further steps and procedures, GIZ-Marco has prepared various documents for Ouarzazate which could be adapted to Iranian conditions.

Option 2: water-saving irrigation methods
There is another interesting alternative use for the vinasse. The sludge will be filled in a vessel witch measures about 2x1.5 meters and 15 cm deep. Crop grains are added. After about 5 days, the grain begins to grow and roots into the whole space until all water is consumed. The mixed root-ground is balled and can be fed to animals as such.

4.1 The path of sanitation systems in Germans History

Biogas is, as we know, the result of an anaerobic fermentation of plant residues in whatever form they occur. If oxygen is present, compost will be produced. Compost was for a very long

period the only source of fertilizer in Germany and whole Europe and world-wide. There was no other important fertilizer than natural products. In medieval times animal and other excrements mixed with straw were set in front of farmhouses to demonstrate the wealth of the owners. The higher manure heap was, the more cows the farmer had and the richer he was.

Biogas as such has of course always been incurred, but never recognized as an energy source and also not used. Biogas, as a source of energy, was first time used in Germany at the end of the 19h century. It covers its own thermal energy demand in the sewage- and compost plants. During and after the so-called Industrial Revolution the masses of workforce migrated from the country side to the cities where they found employment or immigrated to the United States or countries in South America or elsewhere. The forefathers from today's US President Donald Trump e.g. came from a south-western Region in Germany in the 19th century.

In the very time flush toilettes coming from England were introduced and black water was washed into the roads. The sanitary and health problems grew, the condition deteriorated in the city so much, that city council had to react. Underground canalization and sewage plants had to be constructed. The disposal of waste and sewage in the cities had become a major problem which affected the health of the people and their well - being. Something had to be done.

Beginning in the 1850`s, the construction of urban sewage systems began in whole Europe and the US. The underground canalization system in Paris was constructed in 1850, Berlin was done 1856 and Vienna1873. In those days had Germany the same sanitary condition as it had it 2000 years before as part of the Roman Empire.

4.2 Structure of the German waste treatment and sewage system

Germany was, since ever so to say, a feudal organization, composed of a greater number of former tribal regions. This unit was the successor of the Roman Empire, calling itself the "Holy Roman Empire of the German Nation". This empire lasted for almost a thousand years. Germany united it himself 1871 to the German Kaiser Reich (Deutsches Reich), it ended at the end of the II-world war. Since then, Germany is federal again and has been organized in 17 countries (Länder) and 3 cities. Berlin is the capital.

In all countries there are all the administrative units that a modern state needs. Only the Foreign Ministry, the National Defense and the Development aid Ministry exist only on a national level. All ministries have their respective administrative units working on respective areas, usually there are between 10 and 15 units.

Environmental protection is represented in all ministries and has as well its own ministry. It is a cross-section task. Biogas is specifically located in the ministries of environment, energy, agriculture and research.

4.3 German Association for Water, Wastewater and Waste (DWA Policy Memorandum)

Position on environmental policy

- Energy recovery potentials of the water industry
- Climate change - Adaptation strategies at an early stage
- Flood prevention and Water Law - create effective regulations
- Water Framework Directive - Putting management planning into practice
- Anthropogenic traces of traceability
- Sewage plants can be renovated if necessary
- Wastewater disposal constructively
- Fracking - not at the expense of the environment
- Recycling and resource protection

4.4 Organization of sewage systems and solid Waste treatment

Waste systems are large units and can have up to two hundred fifty employees. An average waste treatment plant consumes approx. 100 million GWh, of which 15 million are thermal energy, it processes approx. 100 million m3 of water and costs approx. 50 Mio. Euro / year.

In Germany 99% of the customers are connected and are supplied with drinking water of high quality. The connection degree of sewerage is approx. 96%. The investments in wastewater including Biogas are about 4.5 billion € per year, of which nearly one third in wastewater, 2/3 of the investments goes into in wastewater treatment sector.

The sewage flows through the wastewater sewers in the sewage treatment plant. There, unpleasant articles are filtered out in various stages. The waste water is then fed into the activated sludge reactor, where the wastewater under high pressure and enormous energy input are briefly treated with compressed air, which the degradation bacteria need to degrade the contaminants in the water for growth.

There are various process steps afterword’s for separating individual fractions. The filtered sludge is fed to a biogas plant and fermented. The final product then is biogas, water, carbon dioxide and small amounts of trace elements and some nitrogen compounds. This water is conducted in river and receiving streams and thence into lakes or into suitable swamps if present. With all these measures, the internationally used level 3 is achieved, as is achieved in all classic sewage systems.

4.5 Micro-pollutants in water, air and soil

Any kind of micro-pollutants in the water, in the air and in the ground has caused a national concern since micro pollutants influence negatively the environment in many ways and has a negative impact on the death rate of the human population and other species.

In the meantime, larger financial flows are entering this new area.

The concentrations of micro-pollutants in many waters exceed the legally prescribed environmental quality standards. To reduce the entries, the possible avoidance measure is sufficient such as application restrictions or prohibitions on substance law, product law, reduction of air emissions, so that only a downstream waste water treatment technology promises success. This requires the updating of the prior art in sewage treatment and the introduction of further sewage treatment processes (4th cleaning stage) in the municipal sewage treatment plants as well as smaller ones which are introduced into sensitive waters. The most effective and cost-efficient methods currently available are the processes of ozonation of water waste water and adsorption by powder activated carbon.

4.6 The Sewage and Sewage Sector as a driving force for research and development

Of the approx. 7,000 biogas plants that are currently operate in Germany, about 2000 are operating in municipal sewage systems. They are constantly optimizing operations and guarantee the high level of development of these plants in Germany, thus they sought-after as cooperation partner in Europe and worldwide.

The plant operators themselves are looking for this cooperation.

Since the start of municipal mid19th century wastewater treatment, biogas technology has been a key element in the operation management. The ongoing research and development influences the whole sector. The operation results will be passed on to the entire biogas-sector.

Waste water companies have always been interested in optimizing energy generation and minimizing energy consumption. The biogas produced has always been used for the production of electricity and the use of thermal energy. A particular chapter is the use of biogas as a component in other chemical processes or as a starting material for fuels.

5 Biogas-production from municipal waste

In Germany there are about 40 million private households but as well restaurants, hotels, hospitals and other facilities in which biogenic household waste is produced. Each year, there are about 16 million tons of biogenic wastes, half of which is the direct organic waste of kitchen waste and green waste from parks in other plants and other recyclable sources like from trees in cities.

In a multi-year process, more and more households were recorded and a collection structure was built up. There are however as well private entrepreneurs like larger factory with

research-units or specific production units, like for example sugar beets and other units in the food industry like the milk powder production and poultry. In total there are some 10.000 Sewage Treatment units in Germany, organized in about 2000 cities. The size differs due to population density and specific production of degradable material in the region or city. As a rule of thumb could one assume that at least 100.000 inhabitants share one treatment unit.

See annex 2: Sewage treatment in a lagoon in Ouarzazate in Morocco

5.1 Municipal waste "The money making machine"

Waste management is an objective of the German government's policy. In Germany the waste management sector makes a significant contribution to energy production. The objective of the German government's policy on waste is to achieve a recycling-based economy that conserves resources and reduces adverse impacts on the environment. The aim is to increase and optimize the efficient use of raw materials, to maximize recovery quotas and to permanently remove from the environment. Residual waste can no longer be used literately. This will lead to a substance management within closed substance cycles, i.e. turning today's trash into tomorrow's treasure-trove. Modern waste policy in Germany has triggered the rapid evolution of recovery and disposal technologies – an important green market. Today, the waste industry employs over 250,000 people and generates an annual turnover in excess of several billion €. There are over 15,000 waste management plants in Germany. The infrastructure for all types of waste is in place to reach zero waste.

See annex 3 German solid waste municipal collection system

5.2 Biogas as energy source in the electrical national and local thermal grids

Biogas produced from municipal waste or farms or firms of any kind can be used in local or regional grids. The electricity and thermal energy will be locally used. The adapted motors accept biogas with an e.g. 50:50 CH_4/CO_2 or other ratio.

Biogas in the national natural gas grid. If biogas will be fed in the national natural gas grid has it be to be upgraded to 100% CH_4-energy value, because clients pay for "energy equivalent" and not for volume. That's why standards were set for temperature, pressure and components in the naturel gas grid.

5.3 Sewage Treatment and different types of reactors

The sewage arrives in a sort of liquid consistency in the Sewage treatment system and will be treated in various steps. The "Activated sludge process" is the most important one. Here the degradation of biological material takes place. Huge volumes of air will be pumped with pressure and extreme electricity consumption into the reactor. Diverse bacteria's degrade the sludge. This process is the so-called "Activated sludge process". The units are large, extremely well organized and managed and very costly.

In the operation are four different steps involved, from which the “Activated sludge process” is the core process. The sludge will pass different steps but comes finally to the biogas reactor. The composition of the sludge is directly related to in the input and the composition is linked to what people and production and factories units put into it.

The sludge will be transported to the biogas unit and there again are quite different types and sorts of reactors and consequently different efficiencies, reaction time and quantities. A 50% efficiency is not bad but could be with selected substrates much higher. The sludge is again treated in different manners and generally used in the agricultural sector or even burnt.

What different types do we find generally?

What different types do we find generally? Anaerobic inflow mud reactors (UASB), Anaerobic dive wall reactors (ABR), Temperature controlled batch reactors with continuous mixing (CSTR), completely stirred tank reactors), Covered Biogas-Lagoons, temperature controlled batch reactors with continuous mixing (CSTR), completely stirred tank reactors), Covered Biogas-Lagoons etc.

5.4 Dry Fermentation According to the garage model

The garage model is an arrangement of biogas plants around a tower, which stands in the middle of a square. A garage is standardized and has the extent of 3 x 6 x 2.50 meters. The garages can be arranged square or round on the central square. It is usually about 8 garages. The garage is filled with a bulldozer with pre-sorted organic waste and sealed with a garage door air-tight. Above, there is a sprinkler system in the garage which distributes/spray an aqueous solution enriched with methane bacteria over the whole bio-waste. The sprinkler system moves back and forth from one side of the garage across the entire area on the opposite side. This keeps the whole material wet. At the bottom of the garage there is a basin where the bacteria juice is collected and pumped back to the top of the garage. During the process the bacteria multiply. In order to obtain a constant concentration, the excess aqueous solution is pumped to the central tower. Due to the attack of the bacteria, the cell structure of the biomass disintegrates and other fluids are released which are altogether transported to the Bio-tower. Approximately 80% of the biogas is formed in the tower itself. After approx. 10 days the biogas production decreases slowly. After approx. 10 days the biogas production decreases slowly. The fermentation process is then initiated in the second garage, and biogas production begins. The biogas production in the garages is switched in such a way that a uniform biogas flow is reached, which is converted into a Motor with a generator in electricity and thermal energy which is used in the Biogas-unit. The advantage of the garage technology is that only roughly pre-sorted biomaterial is used. A component separation takes place only after the rotting process that it can be easily filled and emptied refilled and a uniform biogas stream can be produced.

5.5 Biomass- and wood gasification

Biomass gasification is a very old and traditional but optimized a very powerful process in which biomass is carbonized under reduced air supply. If the process is interrupted in a controlled manner, charcoal, tar wood-gas are produced. If the process is carried on to the end, biomass gasification takes place.

About the gasification, the biomass is present as a solid fuel which will converted into a gaseous secondary fuel, which in various utilization options such as power generation or as fuel and fuel (fuel gas) or for use as synthesis gas for chemical synthesis. Similar methods exist for other solid fuels, but especially for the gasification of coal and lignite are very polluting and climate disturbing processes.

5.6 Biochar-production and utilization

Biochar can be produced from any bio-organic solid material what one can find in any so called “normal” environment and could be also mixed wooden waste of any kind and must not be uniform in its composition or completely clean. Substrates from a biogas plant are not very suitable because it contain very little carbonizable biomass. The carbon for the starting material is already used up in the generated CH4 and CO2. The wooden material must firstly be crushed so that it can be transported into the reactor to be heated under anaerobic conditions and will produce Biochar. This process is called carbonization. Biochar stores trace element in the form of Terra Preta. These products serve the plants to growth and also their health and increased resistance of plants against any attacks.

The substrate is first dried mechanically and is then heated to more than 700 ° C with exclusion of air in a reactor. First, the aqueous external moisture of the wood evaporates. Thereafter, the individual different lignin fractions and accompanying substances begin to decompose. Thereafter, the biomass is cracked and wood gas is produced. This also creates a tar-like substance called the wood tar and is very toxic. In the wood tar are very many different chemicals, which also have pharmaceutical effects. The wood gas itself has as low energy content, but is a combustible gas. It can be used in suitable engines for power generation. Through a controlled air supply, the whole biomass can be converted into wood gas. There remains only wood ash.

If the air supply is throttled, all volatiles of the biomass are expelled and it remains a porous carbon skeleton, it is called Bio-char, basically, it's about charcoal.

Different parts from surrounding wood-sources could be added and would increase the proportion of charcoal. The whole process is described in the charcoal chemistry. The German Chemical industry of the 19th century began with the coal chemistry. The wood- and carbon chemistry are basically the same.

Classic wood mailers work on the same principle. It also charred wood under controlled conditions and produce charcoal.

5.7 Biochar-introduction: An option for Germany or Iran?

In principle, bio-char production could be also an option for Germany. Almost 8,000 biogas plants produce approx. 230,000 tons of organic materials. That's pretty much the amount Germany consumes per year in charcoal.

But nobody does that, because it is easier to use charcoal from developing countries, such as Paraguay, than to convert it in bio-charbon.

The production of bio char is complex and harms the environment. It is accepted that thereby e.g. the forests are cut down in Paraguay. Germany imports 34.00 tons, worth about 15. Mio € char-coal/year from Gran Chao in Paraquay. In addition, agriculture and horticulture remove the main end of the digested sludge from biogas plants. It can be assumed that biochar production would not be economically viable in Iran either. In case of doubt, this would have to be proven by a study.

6 Political steps and measures

In 1981 the law „Supply of electricity from renewable energies in the grid“ was passed the German Federal Parliament followed by the „Renewable law“ in 1991. That law was worldwide the first law to regulate feed-in conditions in the national grid. It is understood as a masterpiece of German Technology that permanently changing Renewable electricity production now a days up to 35% can be absorbed by the grid without further problems. Electricity from Biogas is welcome in that context because it can be regulated and thus stabilizing the grid. It can be stored and feed in when required what is not possible with fluctuating wind and solar energy.

6.1 Course title Renewable Energy Law, EEG 2017

This law regulates the penetration of RE-Electricity into the grid and guaranties subsidies under various conditions, what means that the subsidized conditions can and will be changed accordingly market conditions. The law regulates the preferential supply of electricity from renewable sources to the electricity grid and guarantees their producers fixed feed-in tariffs. While the EEG proved to be "very successful" with regard to the expansion of renewable energies, its economic and ecological efficiency as well as partial aspects such as exemptions for the industry are controversially discussed. Each consumed KWh is charged with the so called "Green electricity supply". It is slightly less than 10 Euro-cents in 2017. Large electricity consumers can be exempted from the "Green electricity requirements" for economic policy reasons. The payment for the consumers to the energy producers is not regarded as a subsidy but as an agreement. The EEG 2017 is not understood as very balanced. There are too many officials in the ministries who consider them to be energy experts. They plan to pass by the reality instead of listening to local experts and producers.

6.2 General agreement in German society on the Renewable Energy laws and the nuclear phase-out

In 1991 passed the German Federal Parliament the General assessment of the Renewable Energy laws in Germany. The German Bundestag passed an ongoing number of administrative laws concerning Renewable Energies. The government was supported by a large number of ministries, such as the German Implementing Organization of the Federal Ministry for Economic Cooperation BMZ and its implementation organizations GIZ (German Association for Technical Cooperation) and KfW (Association for Reconstruction) commissions and committees but also by the state parliaments and consultants, RE companies, companies, churches, NGOs, associations and private individuals.
In summary, it can be said that the broad German public supports the idea of Renewable Energies.

6.3 Technology impacts for society – doubts about the speed of change in the society

Perhaps was the implementation of an Energy – and Climate strategy the application of change a little bit too fast and perhaps the country's parliaments pushed too much, because there are rising complaints on too much PV solar systems, too many wind power plants and too many fields with corn and rape and too little respect Nature and environmental protection. For a long time, few major energy conglomerates dominated the energy industry in Germany since the Industrial Revolution in the 19th century. However, government-sponsored competition and the phasing-out of nuclear power now cut off the four main power producers in Germany which are E.ON, RWE, Vattenfall and EnBW.
At the same time, citizens with solar systems and medium-sized companies with wind parks themselves become power producers. It is predictable that all major power producers worldwide will have to change their business model because it is simply no longer economical. Cheap solar and wind power will make it possible to undertake ventures which have so far failed due to excessive electricity prices. There will also be a variety of small to very small companies.

6.4 Requirements for successful Renewable Energy projects

Germany had very good starting conditions for the launch of Renewable Energy projects. Germany is generally highly technical country and the population is interested. In some areas it was difficult however to switch from "small to large", especially in the biogas sector. In the energy-sector where there is a century of experience, but no experience and operation in the production of solar panels and plant operation. Germany had no knowledge about Wind-turbines, they didn´t exists those days jet. It took 15 years for reliable equipment to be on the market, with Denmark helping. The same help will be needed by Iran.

Preconditions: It is very important that the project approach is requested and promoted by national, regional and decision makers.

- The influence of the state on the contractual conditions must be clarified
- The role of contractors and subcontractors must be clear
- Is there a financing model? Who is involved in what?
- Who benefits from the program and who could be harmed?
- Clarify citizen participation
- Launch training program
- Is there already a maintenance infrastructure?
- Who looks after the project after the project has been handed over?
- Is there an Energy Supply Contracting Model? ESC)
- Are there any settings and conditions relevant to energy saving & service programs?

6.5 Negative effects of large Bioenergy farms

The most criticism from all Renewable Energy-projects got the biomass sector, especially agriculture and cattle farming. Through the subsidization of biogas plants through the EEG from 2004 onwards and the actualization in 20017 many farms have switched to biogas production. A consultancy scene, production companies, monitoring and protection units, government controls, veterinary services, water and air controls, animal protection organizations and many other units developed.

The expansion of livestock farms led to bottlenecks in the number of cows needed and a cow transport tourism across Europe.

Whole the country was confronted with the cultivation of rape and maize for the use of biogas plants and energy production. This applies in particular to large land areas in the east of Germany, which were created only by the takeover of large-scale farms, mainly by Dutch citizens and German nobles after German reunification. The landscape became more and more uniform, the biodiversity declined drastically, everything became more monotonous, and the diversity was lost.

Farmers' machinery, which used semi-industrial biogas plans, grew in size; farms were run as industrial complexes and assigned to energy production. The policy found itself compelled to standardize guidelines for the size of facilities and reduce subsidies. Many companies reported insolvency nationwide. The reputation of the previously recognized technology has been tampered with and has been consistently damaged by the population.

The continuous rise of cows for biogas production had two very special negative aspects: once more, more and more agricultural land had to be used for maize and rape production, but secondly, ever larger quantities of feedstuffs such as soya and palm oil were imported to

produce even higher amounts of milk the dairy industry. Thus a kind of vicious circle was initiated.

However, it cannot be that peaceful German society is responsible for the clearing of tropical forests and the expulsion of indigenous peoples, only to enable German cows to produce more manure for biogas plants and milk for the production of milk powder.

6.6 The biogas-sector had been consolidated meanwhile

Legislation has focused on the criticism of society and imposed restrictive measures.

In the meantime, the biogas industry has been consolidated and diversified. The technology is competitive and recognized nationally and internationally in the given framework. The moral of the story is that from the very beginning society must deal with the consequences of decisions that deal with natural and slow biological processes. This includes international exchange, knowledge and experience transfer, as exemplified by today's conference.

6.7 The Solar-energy-sector

The PV energy revolution with a dramatic decrease in the cost of PV-electricity

The price of PV power drops and falls recently in Saudi Arabia under favorable conditions to 2 € -cent / Kwh. That's sensationally little. A tenfold price would not be bad for some other parts in the world. It hogs up the business of the classic Energy utilities, so that they now think about a transit fee. Decentralized power generators fed into the grid which was actually intended for the absorption of large amounts of electricity by a few large producers and not for very many, possibly infinitesimal small PV electricity producers.

This favorable price for Western European conditions will trigger a revolution in sunny regions, but especially in poorer so-called third world states. Although there will be a total investment there relatively more expensive than in Germany, because not only the pure panel, but also the Inverter plus framing and wiring and foundation has its price. But: Smaller amounts of electricity with low production costs meet exactly the needs of smaller households and businesses.

This indispensable situation is forcing electricity producers to communicate with the medium and small producers. The old business model is running out as a model - provided that policy sets the right course.

The change is taking place in Germany. The big four German energy producers have reacted and changed their business model and thus just escaped bankruptcy. They have, so to say, to reinvented themselves out of necessity.

6.8 The wind-energy-sector

In Europe windmills have been known since the 12th century. They were built from the outset as a buoyancy rotor with a horizontally located rotor axis, which is still the basic principle of

modern wind power plants. In Europe it is known however that vertical wind-machines were used in Persia and China 2000 years ago. Windmills were mainly used for milling grain and water mills for sawing wood. At no time and even today, had windmills a certain acceptance problem.

The installed windmills were getting bigger and bigger by the time. The efficiency of wind turbines depends on the wind speed in the third potency. This is why the wind-towers turbines get always higher because the higher the wind speeds the higher is the energy-output.

The Renewable Energy Sources Act (EEG) is the driving force for the expansion of renewable energies in Germany and thus also for the expansion of wind energy, one of our most important climate protection instruments. From 1980 onwards the windmills production grew rapidly from nearly nil to some 30.000 to date.

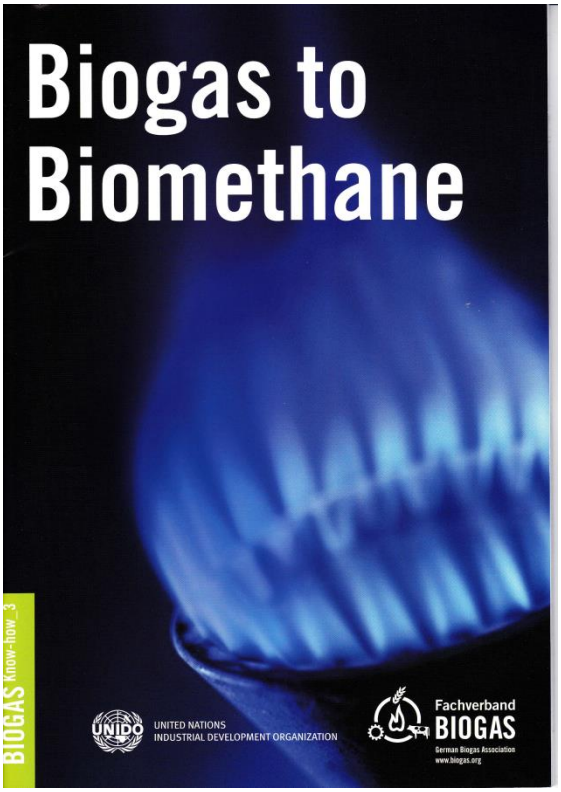
In Germany were in 2016 about 50,000 megawatts produced and thus about 12% of the electricity consumed in Germany. As a result, Germany was once again the front runner in Europe, and this also applies to new installations. As that result, wind power plants make the largest contribution to electricity generation from renewable energies. Various plants with different sizes were installed. It is about small plants up to about 10 KW, medium-sized plants up to about 2000 KW and large plants up to about 5 MW. These are usually installed off-shore.

Annex 4: Examples from Morocco/Maghreb

Bottom line

Over the centuries, Germany has developed from an agricultural state into a modern industrial state, which, however, maintained its federal status until the 19th century and resumed it after the end of the World War II. It was only through the so-called "Industrial Revolution", which began in England, that the flush-toilette was introduced, which spread from there on world-wide. This set the course for our society of today and rejected "green agriculture and horticulture", which was based on the reuse of excrements of any kind and thus also a green way for Climate Change. The option to consider water flushes as well as the alternative "dry toilet" or comparable procedures at least as parallels, as practiced in many countries, was never seriously considered. If the option had been considered in which biogas could still be produced, our present world would be quite different.

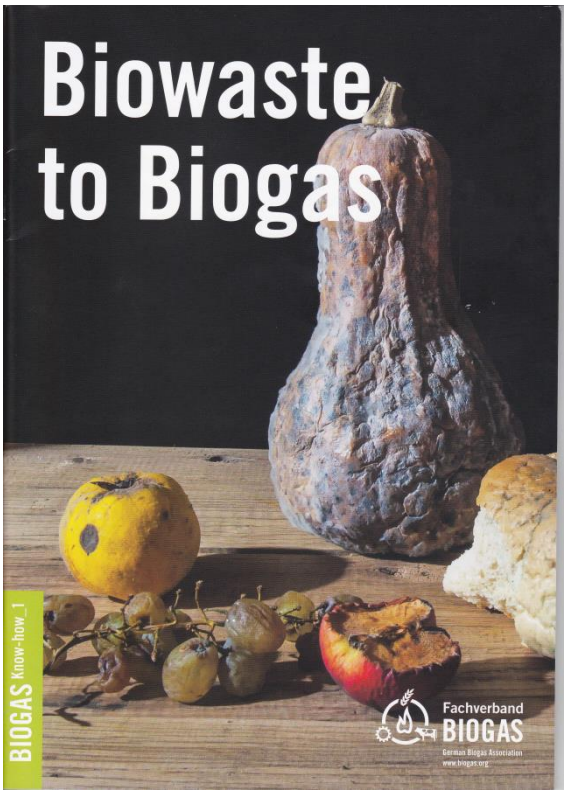
Background information to Biogas utilization and Biowaste



Example of Content

- Production and use of biogas
- Pre-treatment
- Biogas upgrading technologies
- Biomethane utilization
- Biomethane applications
- Technological innovations and perspectives
- The promotion of biomethane in developing and emerging countries (UNIDO)

September 2017



Example of Content

- Production of biogas
- Biogas use
- Feedstock
- Feedstock preparation
- Digester technology
- Digestate application
- Reference plants

May 2016

The source of information is German Biogas Association (Fachverband Biogas, represents Biogas Producers and Applicators) – www.biogas.org

Me, the author of the “Synopsis of experiences in the German Biogas – sector” thanks the German Biogas Association for the brochures in English, which could be ordered online.

Consideration

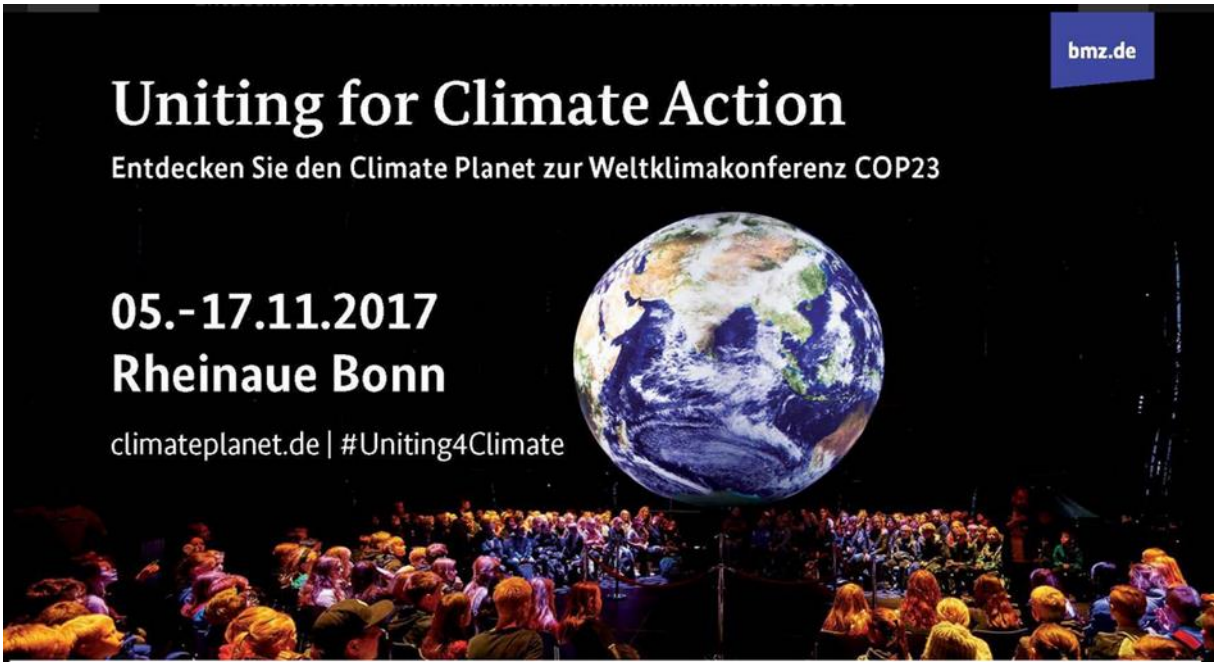
In the course of time developed Germany from the agrarian society to a highly modern industrial state. Germany has developed meanwhile a very interesting and lucrative waste disposal and recycling technics as part of a Green Economy approach in the context of an imminent climate change. The nomination of a lead ministry in Iran and a cooperation with e.g. the Mashhad would be fruitful within the frame of Green Energy Cooperation with Iran. Ultimately helping the climate and all of us, just planting trees and stopping the destruction of the environment instead of massive deforestation of forests and focus of agriculture on energy farming instead of biodiversity. To moderate the consequences of a climate change only moderate lifestyles and firm belief help. What is needed are new ways of producing and working, reducing waste, recycling materials, recycling presets and electromobility in transport.

This knowledge report is dedicated to the German post-war biogas pioneer Uli Werner.

Rolf-p. Owsianowski Berlin, 26th October 2017

Annex

Annex 1 in chapter 3:COP23 in Bonn Germany



Opening of the COP23 -. Photo by www.bmz.de

Annex 2 in chapter 5:Sewage treatment in a lagoon in Ouarzazate in Morocco

The Biogas-Lagoon in Ouarzazate is fed with municipal sewage water. A certain area has at the beginning of the ponds had been separated for sludge precipitation where sludge burden water flows towards a floating curtain and is covered it with a plastic dome. 90 % of the sludge remains in that area and produces Biogas, which drives a motor for electricity production. The rest of the water is distributed within four ponds. This technique does consume very little electrical energy, but needs a lot of space and is therefore very suitable for a desert region like Ouarzazate in Morocco. The technology was developed with the assistance of the Belgium Cooperation. This approach has not a high reputation in Morocco and Ouarzazate because no hardcore technology is involved. Actually, this is exactly its advantage.

Sewage treatment in a lagoon in Ouarzazate in Morocco

Wastewater treatment in algae-ponds (Algae as small green factories)

There are a large number of different algae. They grow in fresh water and in salt or cracked water. Basically, they can convert with sunlight and CO2 wastewater in useable biomass and even fuels. But they also need minerals to grow. These can be obtained preferentially from municipal wastewater, which thereby also will be cleaned.

Annex 3 in chapter 5.1: German solid waste municipal collection system

Owsianowski's Reblaus Hausgemeinschaft Handjerystrasse in 12159 Berlin Germany

Apartment-block in Lauterstrasse in 12159 Berlin Germany

Today there are 4-5 different colored tins or containers in almost all German houses or house Communities. Any of the waste generated must pay for its treatment. The levy depends on the size of the producer and the type of waste. Private households are assessed according to their number of residents, it varies between 10 and 100 € per unit.

Annex 4 in 6.8: Example from Morocco/ Maghreb

Example from Morocco/Maghreb, an interesting partner country for Iran

Morocco PV in Errachidia and Boudnib - Photo by Dieter Uh